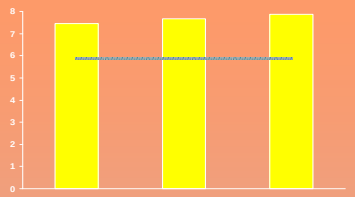

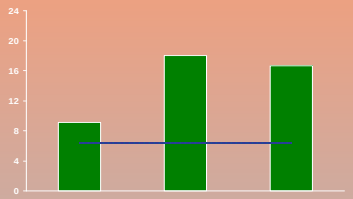

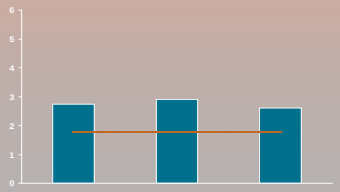

Comments On The Proposed CARB Alternative Fuel Specifications

Steven Sokolsky
Bevilacqua-Knight, Inc. *

BEVILACQUA KNIGHT, INC

* BKI's participation is funded by Occidental of Elk Hills, Inc.

Major Points

- NGV population remains miniscule in terms of total California vehicle inventory - number of “legacy” vehicles < 3,500 statewide, < 2 dozen in SCC & SSJV
- Experiences with existing MN-73 & MN-80 exemptions prove compositional specs are no longer necessary
- Only vehicles affected by change to MN-spec would be HD transit & school buses, refuse haulers – LD & MD vehicle capable using low MN fuels
- HD vehicles rarely fuel at more than one station – situation is localized
- New HD engine technologies allow lower MN fuels, even as low as MN-65
- Emissions testing indicates air quality is not significantly impacted by higher BTU gases

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California Vehicle Populations

Total California vehicle population:	**25 million**
Total number of NGVs:	**~25,000 (0.1%)**
Total number of "legacy" vehicles in SCAQMD territory:	**~3,300 (0.01%)**
Total number of "legacy" vehicles in SJV and Coast regions:	**~35 (0.0001%)**

Legacy vehicles: pre-2002 vehicles needing up to MN-80 fuel due to potential knocking problems

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Ongoing Experience with Methane Number Exemptions

- Currently 28 stations receive exemptions from CARB to use MN-based specification
- 7 MN-80 with blending (~22 vehicles), 9 MN-80 w/o blending (~950 vehicles – mostly LA MTA buses), 12 MN-73 w/o blending (~105 vehicles)
- No major performance problems can be attributed to gas quality

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CAVTC Test Results: General Observations

- Fuel economy and PM emissions improve with lower MN fuels
- Ranges of NOx & THC, CO and NMHC emissions are mixed and did not correlate strongly to MN number
- Average CO_2 emissions trended slightly lower with higher MN number
- Note: Vehicles were not optimized for performance or emissions on each fuel

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Test Fuel Composition

NG FUEL COMPOSITION	#1 High Inerts/C_3+	#2 High C_3+	#3 High Ethane	#4 Comm. Grade	CARB SPEC
METHANE NO.	73	78	81	99	
METHANE	82.06	87.25	87.11	94.97	Min = 88.00
ETHANE	7.11	5.84	8.25	3.02	Max = 6.00
PROPANE	3.83	3.06	1.81	0.14	C_3+ Max = 3.00
ISO-BUTANE	0.35	0.28	0.09	0.02	
N-BUTANE	0.63	0.55	0.17	0.02	
ISO-PENTANE	0.06	0.08	0.02	0.01	
N-PENTANE	0.04	0.07	0.02	0.01	
C_6+	0.00	0.05	0.01	0.00	
CO_2	4.99	2.37	1.88	0.59	Range = 1.5-4.5
N_2	0.94	0.45	0.64	1.20	
OXYGEN	0.00	0.00	0.00	0.03	Max = 1.00
TOTAL	100.01	100.00	100.00	100.00	
NET HEAT VALUE (BTU/CF)	983	999	973	905	

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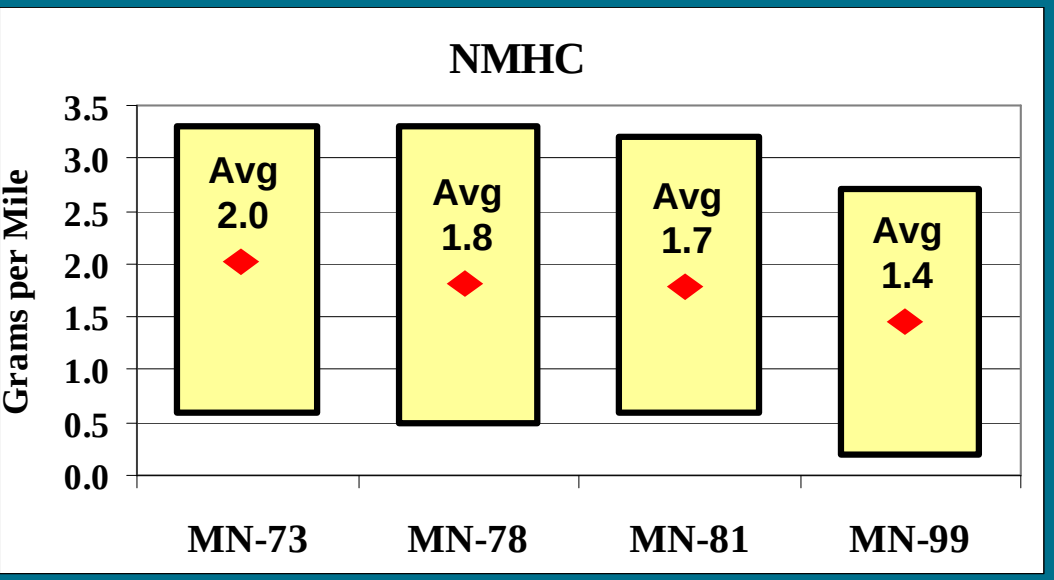
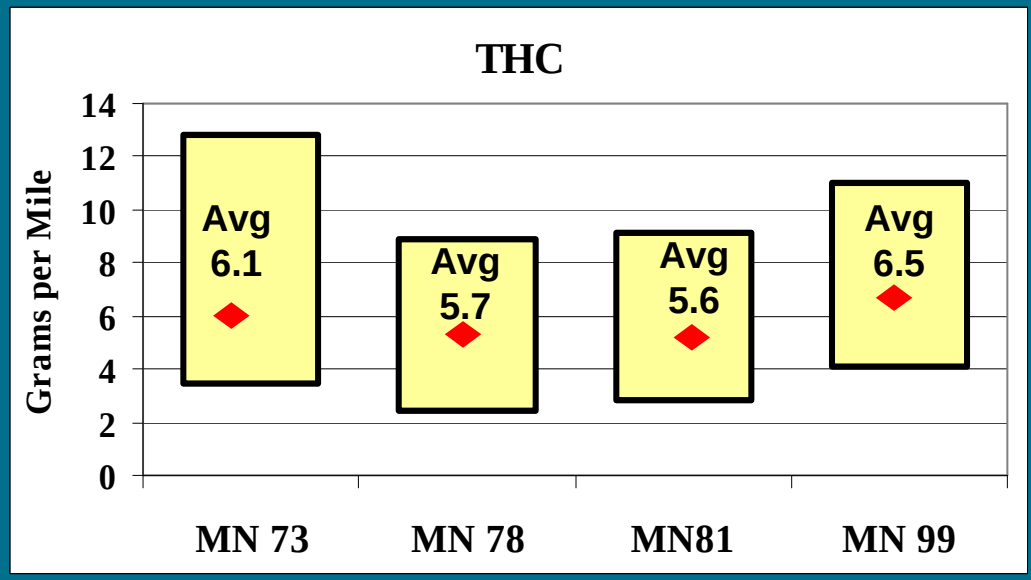
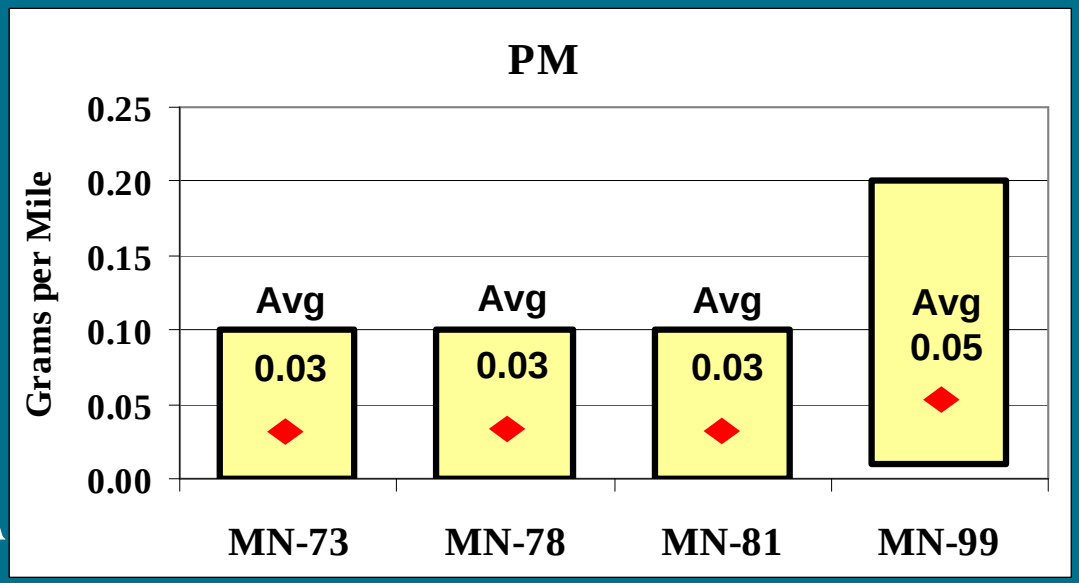
Highlighted areas do not comply with CARB spec

Comparable Emissions







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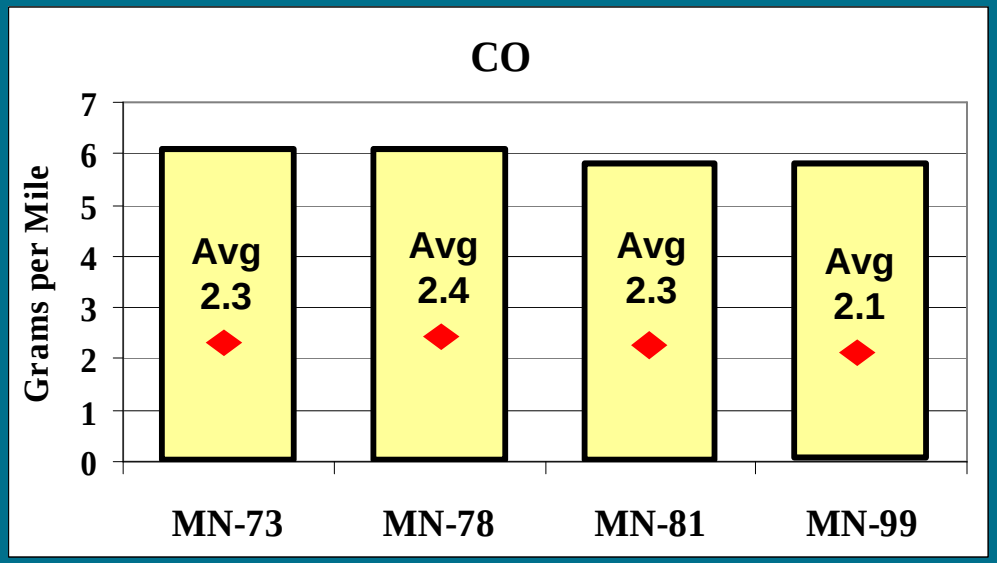
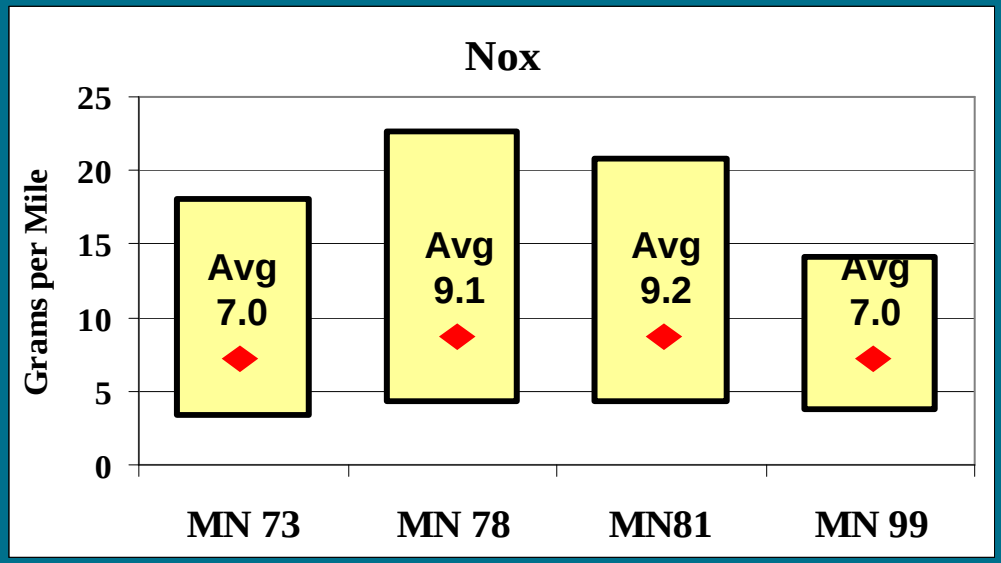
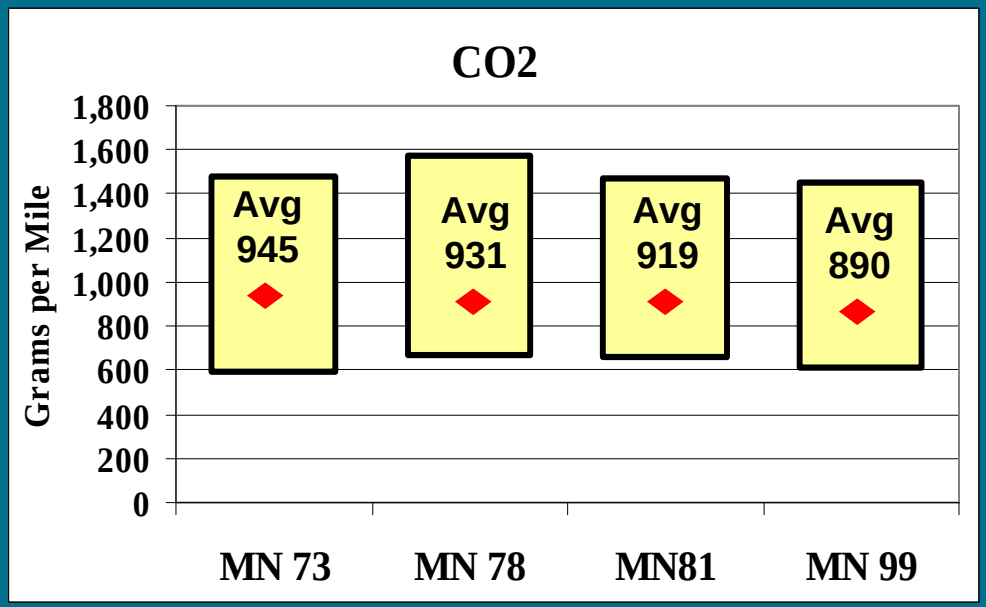
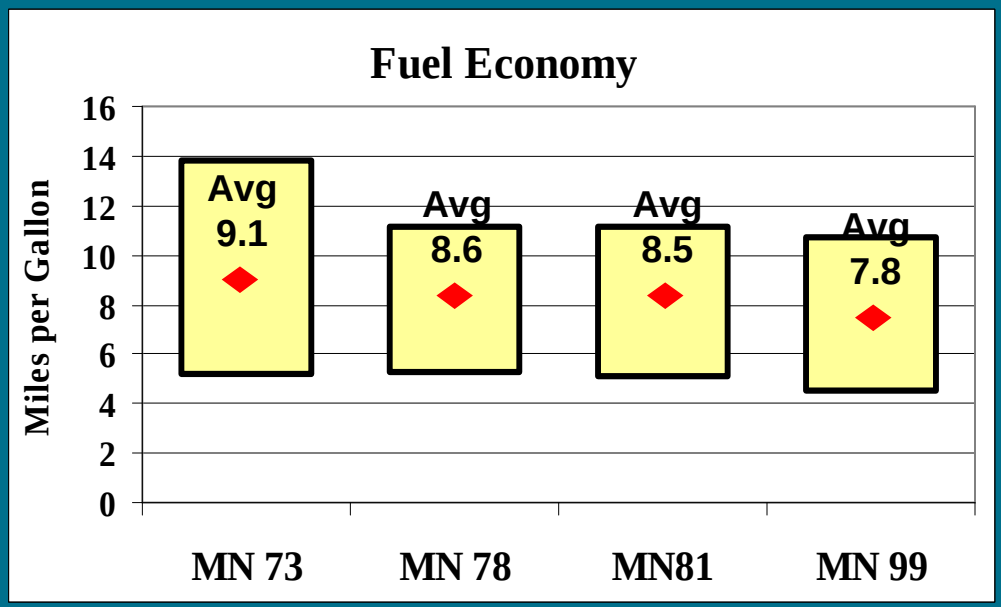
Comparable Emissions









Case Study

Kings Canyon USD CNG Station

- Meets CNG fueling needs of 3 school districts, 3 rural transits & UPS – 30 fleet vehicles total
- Currently receives CARB exemption – ethane level regularly over CARB spec of 6% - ranges as high as 8%
- Vehicles consistently running on higher BTU gas: ~1075 BTU/cf
- Kings Canyon buses (16 John Deere 8.1L – 1996 to 2002 MY) have run >500K miles with no major performance or maintenance problems

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Conclusions

- Number of vehicles affected by draft spec is small
- Previous experiences using MN-specs are positive
- HD vehicles belong to fleets and fuel at same location every day – any problems can be easily addressed
- Emissions tests demonstrate negligible changes in air quality with “richer” fuels
- All new HD NGVs are capable of running on MN-73 or lower: LD & MD vehicle performance unaffected
- Move to MN-spec benefits NGV industry, end-users & producers
- ARB should consider moving to statewide MN-73 spec as older engines are retired

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